

1

September 4, 2021

Stephen E. Petty, P.E., C.I.H., C.S.P. - EES Group, Inc.

Concepts of Industrial Hygiene Exposure / PPE / Warnings Applied to COVID-19 & Masks

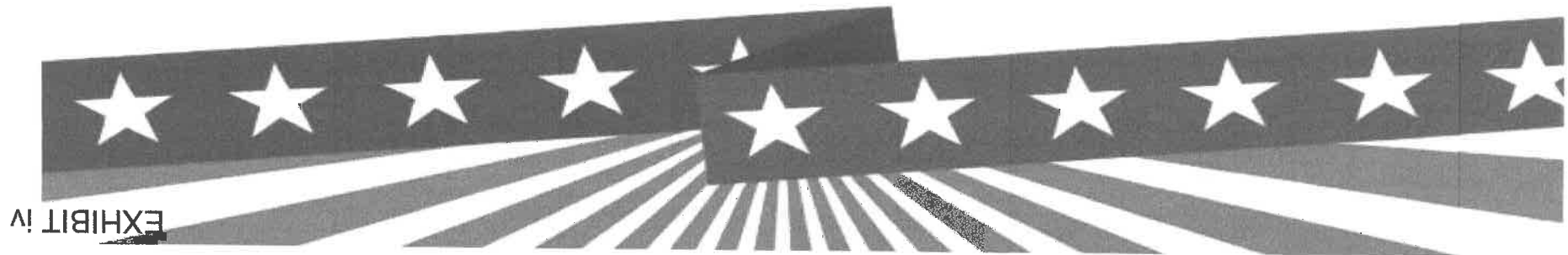


EXHIBIT iv



Concepts of Industrial Hygiene

Exposure / PPE / Warnings

Applied to COVID-19 & Masks

Stephen E. Petty, P.E., C.I.H., C.S.P. - EES Group, Inc.

September 4, 2021

BACKGROUND



- **President and Owner of EES Group, Inc. (Forensic Engineering Company – Since 1996 – 25 years)**
- **Section Manager and Sr. Research Engineer, Columbia Gas (10 years)**
- **Sr. Research Engineer, Battelle (10 years).**

PETTY QUALIFICATIONS

Education: B.S. Ch. E., M.S. Ch. E. (honors at both levels) and M.B.A. (1st in Class)

Sr. Research Scientist – Battelle

Sr. Research Engineer/Section Manager - R&D – Columbia Gas

President, EES Group – Engineering EHS Company, Columbus, OH. – 100s of projects

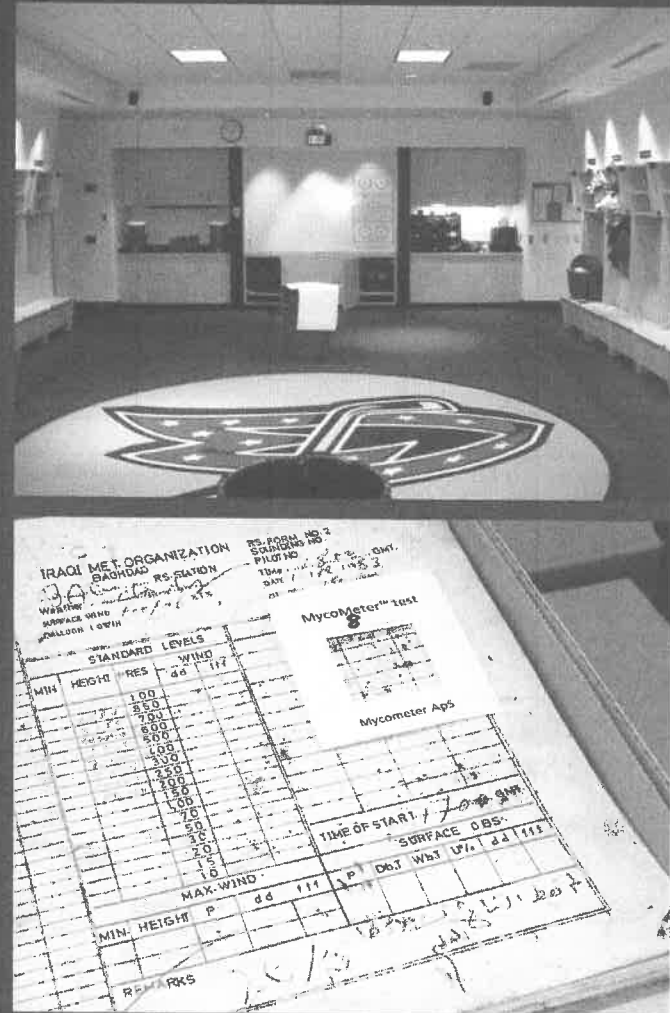
CIH (National Certification), C.S.P. & Professional Engineer (OH, FL, PA, WV, KY, and TX)

National Exposure/PPE Expert (e.g., Monsanto Roundup, DuPont C-8); ~400 Cases

Selected to determine general causation outside of litigation on dozens of projects (e.g., Iraqi Docs – Allegany Ballistics Lab – Columbus Blue Jackets; Prof. Hockey locker room – Columbus College of Art & Design, CMH Airport RA)

Adjunct Professor – Franklin University (Teach Environmental and Earth Sciences)

Nine U.S. Patents – mostly wrt Heat Pumps.



PETTY QUALIFICATIONS

➤ Memberships:

- American Industrial Hygiene Association (AIHA)
- American Board of Industrial Hygiene (ABIH)
- American Conference of Governmental Ind. Hygienists (ACGIH)
- American Institute of Chemical Engineers (AIChE)
- American Society of Refrigeration, Air Conditioning and Refrigeration Engineers (ASHRAE); Member ASHRAE 40 Std. and TC 8.3
- American IAQ Council
- Sigma Xi.



PETTY PODCASTS

All this information detailed in Video Petty Podcasts
Podcasts #2 through #6:



The image shows the Rumble channel page for 'Petty Podcasts'. At the top, there's a navigation bar with the Rumble logo, 'Videos', and a search icon. Below this, the channel name 'Petty Podcasts' is displayed with a profile picture and a 'SUBSCRIBE (11)' button. The main banner features a microphone and the text 'PETTY PODCAST By Stephen Petty, PE, CIH, CSP'. Below the banner, there are three video thumbnails with their titles and episode numbers. To the right of the videos, there are sorting options: 'SORT BY' (Default (general), Latest), 'DATE' (Today, Last week, Last month, Last year, All time), and 'DURATION' (Any, 1 hour, 1 day, 1 week, 1 month, 1 year).

Petty Podcasts
307 Rumbles

Petty Podcasts
By Stephen Petty, PE, CIH, CSP

Children & Masks, CDC Document Review (3 of 4) - Ep. 13
Petty Podcasts
1,115 views • 39 rumbles • Aug 22

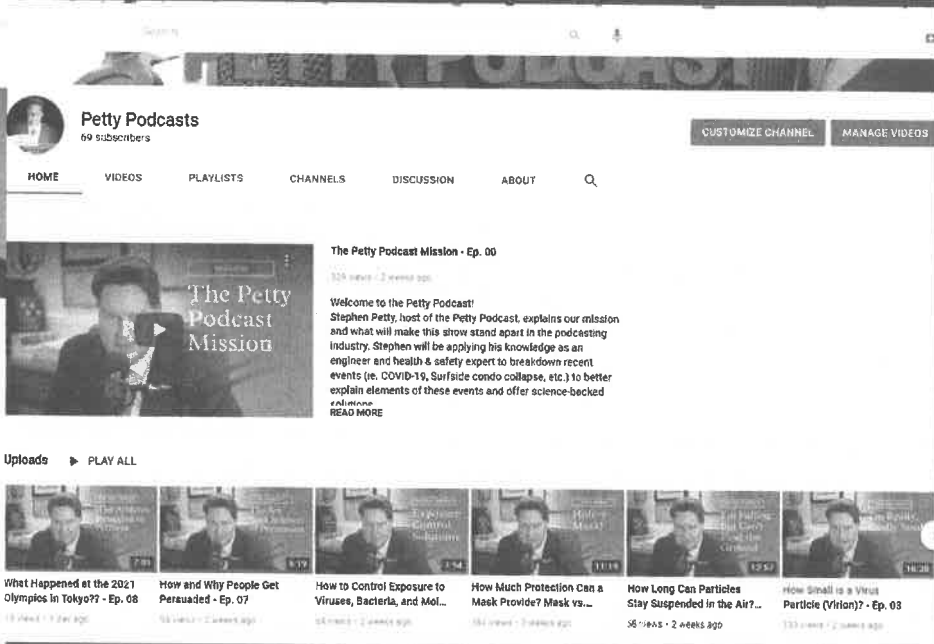
Children & Masks, CDC Document Review (2 of 4) - Ep. 12
Petty Podcasts
723 views • 36 rumbles • Aug 21

Children & Masks, Efficacy & Negative Effects (Part 4 of 4) - Ep. 14
Petty Podcasts
962 views • 46 rumbles • Aug 22

SORT BY
Default (general)
Latest

DATE
Today
Last week
Last month
Last year
All time

DURATION
Any
1 hour
1 day
1 week
1 month
1 year



The image shows the YouTube channel page for 'Petty Podcasts'. At the top, there's a navigation bar with the channel name 'Petty Podcasts' and a 'SUBSCRIBE' button. Below this, there are tabs for 'HOME', 'VIDEOS', 'PLAYLISTS', 'CHANNELS', 'DISCUSSION', and 'ABOUT'. The main content area features a video titled 'The Petty Podcast Mission - Ep. 00' with a description: 'Welcome to the Petty Podcast! Stephen Petty, host of the Petty Podcast, explains our mission and what will make this show stand apart in the podcasting industry. Stephen will be applying his knowledge as an engineer and health & safety expert to breakdown recent events (ie. COVID-19, Surfside condo collapse, etc.) to better explain elements of these events and offer science-backed solutions.' Below the video, there's a section for 'Uploads' with a 'PLAY ALL' button. Below this, there are six video thumbnails with their titles and episode numbers.

Petty Podcasts
69 subscribers

HOME VIDEOS PLAYLISTS CHANNELS DISCUSSION ABOUT

The Petty Podcast Mission - Ep. 00
129 views • 2 weeks ago
Welcome to the Petty Podcast!
Stephen Petty, host of the Petty Podcast, explains our mission and what will make this show stand apart in the podcasting industry. Stephen will be applying his knowledge as an engineer and health & safety expert to breakdown recent events (ie. COVID-19, Surfside condo collapse, etc.) to better explain elements of these events and offer science-backed solutions.
READ MORE

Uploads ▶ PLAY ALL

What Happened at the 2021 Olympics in Tokyo?? - Ep. 08
19 views • 9 days ago

How and Why People Get Persuaded - Ep. 07
16 views • 2 weeks ago

How to Control Exposure to Viruses, Bacteria, and Mol...
16 views • 2 weeks ago

How Much Protection Can a Mask Provide? Mask vs...
16 views • 3 weeks ago

How Long Can Particles Stay Suspended in the Air?...
16 views • 2 weeks ago

How Small is a Virus Particle (Virus)? - Ep. 03
133 views • 2 weeks ago

In Google you should find us at Rumble & YouTube - the links are:

<https://rumble.com/c/PettyPodcasts> - not censored – see #5-6 and #11-14

https://www.youtube.com/channel/UCwPHqgMiWwjpqd5dA-Og_Ag - censored!

SCHOOL DISTRICT SUPPORT

**Oakstone Academy (Special Needs School) – Westerville, OH
– Dr. Becky Morrison – Two Podcasts – No Masks /
Engineering Controls – Implemented August 2020:**



Dr Becky and Stephen Petty Pt 1

YouTube · Dr Douglas G Frank
Mar 22, 2021

3 key moments in this video



Dr Becky and Stephen Petty Pt 2

YouTube · Dr Douglas G Frank
Mar 22, 2021

Part 1 Video Link (Dr. Morrison): <https://rumble.com/vkhlrn-dr-becky-oakstone-academy-and...>

Part 2 Video Link (Stephen Petty): <https://youtu.be/oYEo4T6V25w>

School and Students Doing Well without Masks for 2020-2021 School Year

LITIGATION SUPPORT

1. Boone County, Kentucky – Testified on May 17, 2021 against the Governor's Mask Mandate



Filing # 125367129 E-Filed 04/21/2021 04:23:35 PM

IN THE CIRCUIT COURT OF THE EIGHTH JUDICIAL CIRCUIT
IN AND FOR ALACHUA COUNTY, FLORIDA

JUSTIN GREEN,

Case No. 2020-CA-1249

Plaintiff,

v.

ALACHUA COUNTY,

Defendant.

PLAINTIFF'S EXPERT WITNESS DISCLOSURE

COMES NOW JUSTIN GREEN ("Plaintiff"), notifying all interested parties of the retention of Plaintiff's Expert Witness, Stephen E. Petty, P.E., C.I.H., C.S.P., and saying:

Attached hereto are the following exhibits:

Exhibit A – *Curriculum Vitae* of Stephen E. Petty, P.E., C.I.H., C.S.P.

Exhibit B – List of Prior Cases Wherein Expert Testified

Exhibit C – Expert Witness Report of Stephen E. Petty, P.E., C.I.H., C.S.P.

2. Alchua County, FL – County Mask Mandate – Named Expert – On Hold – 4/21/2021

3. Polk County Public Schools, FL – Filed Affidavit Against Masks and for Engineering Controls– 6/1/21

DEFINITION OF INDUSTRIAL HYGIENE (AIHA)

“That science and art devoted to the anticipation, recognition, evaluation, and control of those environmental factors or stressors arising in or from the workplace, which may cause sickness, impaired health and well-being, or significant discomfort among workers or among the citizens of the community.”

Key Tenants of the Field of Industrial Hygiene (to stop or limit exposures):

1. Anticipation
2. Recognition
3. Evaluation
4. Control.

INDUSTRIAL HYGIENE (IH)

- **Field Associated with Exposure, PPE, and Warnings**
- **Not Recognized by Much of the Public, Media, & Governmental Officials – Thus Media often rely on M.D.s Instead for Information on Controlling Exposures**
- **Not Associated with Dentistry!**

EXPOSURE ROUTES

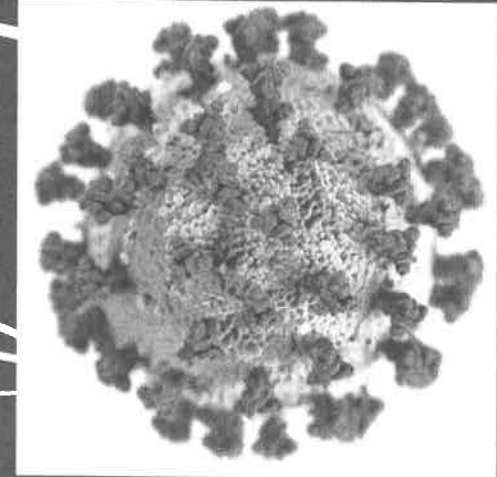
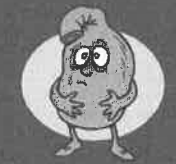
Exposure, in General, Can Occur from One of Four Primary Pathways – For COVID it is the Inhalation Path:

➤ Inhalation

➤ Dermal

➤ Ingestion

➤ Intravenous.



EXPOSURE

Exposure is a function of 2 main parameters:

1. Concentrations – lower is better.

2. Time(s) – less time better.

Distance – further away from source is better - sometimes.

To Minimize Exposure(s)

Most Effective

Substitution / Elimination
(N/A to COVID)

Engineering Controls
(Dilution / Destruction / Containment)

Administrative Controls
(Limit Times in Exposure Area)

PPE
(e.g., respirators)
(not Masks)

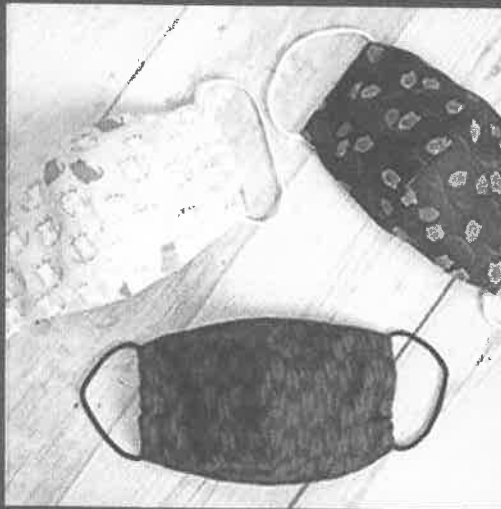
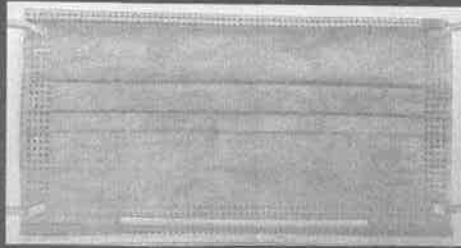
Least Effective

Masks

SO WHERE ARE THE BOUDARIES?

Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 14 of 57 PAGEID #: 161

Not PPE – Cannot be Sealed



PPE – Can be Sealed



N-95



**Half Face
Respirator**

Masks are not Respirators: Terms often Conflated

Masks vs PPE – What Does OSHA Say?

OSHA Confuses the Public – Says Wear Masks on Pg. 1 but on Pg. 6 says they are not protective.....

Additional Considerations for PPE

Interim guidance for specific types of workers and employers includes recommended PPE ensembles for various types of activities that workers may perform. In general:



- *PPE may be needed when engineering and administrative controls are insufficient to protect workers from exposure to SARS-CoV-2 or other workplace hazards and essential work operations must continue.*
- *If workers need respirators, they must be used in the context of a comprehensive respiratory protection program that meets the requirements of OSHA's Respiratory Protection standard (29 CFR 1910.134) and includes medical exams, fit testing, and training.*
 - ***Surgical masks are not respirators and do not provide the same level of protection to workers as properly-fitted respirators. Cloth face coverings are also not acceptable substitutes for respirators.***

Masks are not Respirators: - Terms often Conflated – Leak around edges and cannot be fit tested. CDC says the same!

Masks vs PPE – CDC Says the Same Thing

CDC Also Confuses the Public – Says Wear Masks but says...

Understanding the Difference

| |  Surgical Mask |  N95 Respirator |
|--------------------------|--|---|
| Testing and approval | Cleared by the U.S. Food and Drug Administration (FDA). | Evaluated, tested, and approved by NIOSH to per the requirements in 42 CFR Part 84. |
| Intended Use and Purpose | Field resistance and provides the wearer protection against large droplets, splashes, or sprays of bodily or other hazardous fluids. Protects the patient from the wearer's respiratory emissions. | Reduces wearer's exposure to particles including small particle aerosols and large droplets (only when used correctly). |
| Seal Fit | Loose fitting | Tight-fitting |
| Fit Testing requirement | No | Yes |
| Seal Check requirement | No | Yes. Required each time the respirator is donned (see 42). |
| Filtration | Does NOT provide the wearer with a substantial level of protection from inhaling smaller airborne particles and is not considered respiratory protection. | |
| Leakage | Leakage occurs around the edge of the mask when user inhales. | |
| Use Limitations | Disposable. Discard after each patient encounter. | |

MASK

VS

RESPIRATOR

Does NOT provide the wearer with a reliable level of protection from inhaling smaller airborne particles and is not considered respiratory protection

Filters out at least 95% of airborne particles including large and small particles

Leakage occurs around the edge of the mask when user inhales

When properly fitted and donned, minimal leakage occurs around edges of the respirator when user inhales

Masks Not Good for Fire Smoke Particles but OK for Small COVID-19 Particles

Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 17 of 57 PAGEID #: 164

Cloth masks will not protect you from wildfire smoke.

Cloth masks that are used to slow the spread of COVID-19 by blocking respiratory droplets offer little protection against wildfire smoke. They might not catch small, harmful particles in smoke that can harm your health.

N95 and KN95 respirators can provide protection from wildfire smoke and from getting and spreading COVID-19. CDC does not recommend the use of N95 respirators in non-healthcare settings because N95 respirators should be reserved for health care workers. KN95 respirators are commonly made in China and are similar to N95 masks commonly used in the United States. Look for KN95 masks that meet requirements similar to those set by CDC's National Institute for Occupational Safety and Health (NIOSH) for respirators.

Particles from smoke tend to be very small, with a size range near the wavelength of visible light (0.4–0.7 micrometers) – Cloth masks won't work.

But COVID-19 Particles are ~0.1 microns (micrometers) – smaller sized particles but will work.

WHAT – Does this make any sense?

CLOTH MASKS NOT EFFECTIVE BUT STILL USE THEM

Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 18 of 57 PAGEID #: 165

Effectiveness of Cloth Masks for Protection Against Severe Acute Respiratory Syndrome Coronavirus 2 by Abrar A. Chughtai, Holly Seale, and C. Raina Macintyre, 2020 – Published by CDC)

States: “In 2015, we conducted a randomized controlled trial to compare the efficacy of cloth masks with that of medical masks and controls (standard practice) among healthcare workers in Vietnam (4). Rates of infection were consistently higher among those in the cloth mask group than in the medical mask and control groups. This finding suggests that risk for infection was higher for those wearing cloth masks.”

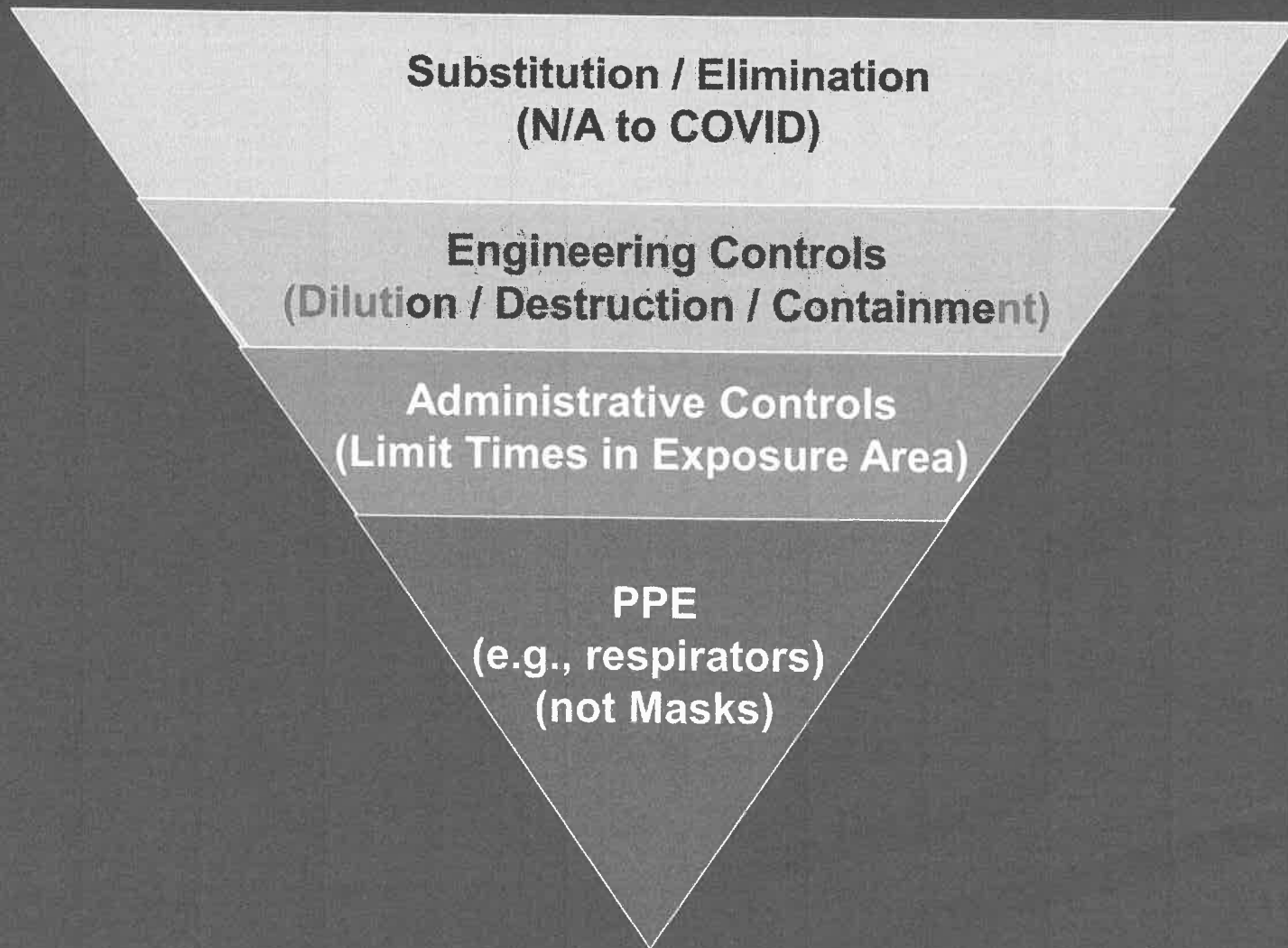
Yet, they say use mask because: “The *primary transmission routes* for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) are thought to be inhalation of respiratory droplets and close contact.”

NO, Not Surfaces or Droplets, but Aerosols!

Some Very New Analyses Regarding Masks

To Minimize Exposure(s)

Most Effective



Least Effective

Masks

AIHA GUIDANCE DOCUMENT

American Industrial Hygiene Association (AIHA)



HEALTHIER WORKPLACES | A HEALTHIER WORLD

Reducing the Risk of COVID-19 Using Engineering Controls

Guidance Document

aiha.org

Version 4 | September 9, 2020

September 9, 2020 Guidance on COVID-19 from AIHA

<https://aiha-assets.sfo2.digitaloceanspaces.com/AIHA/resources/Guidance-Documents/Reducing-the-Risk-of-COVID-19-using-Engineering-Controls-Guidance-Document.pdf>

AIHA VERSION – Hierarchy of Controls

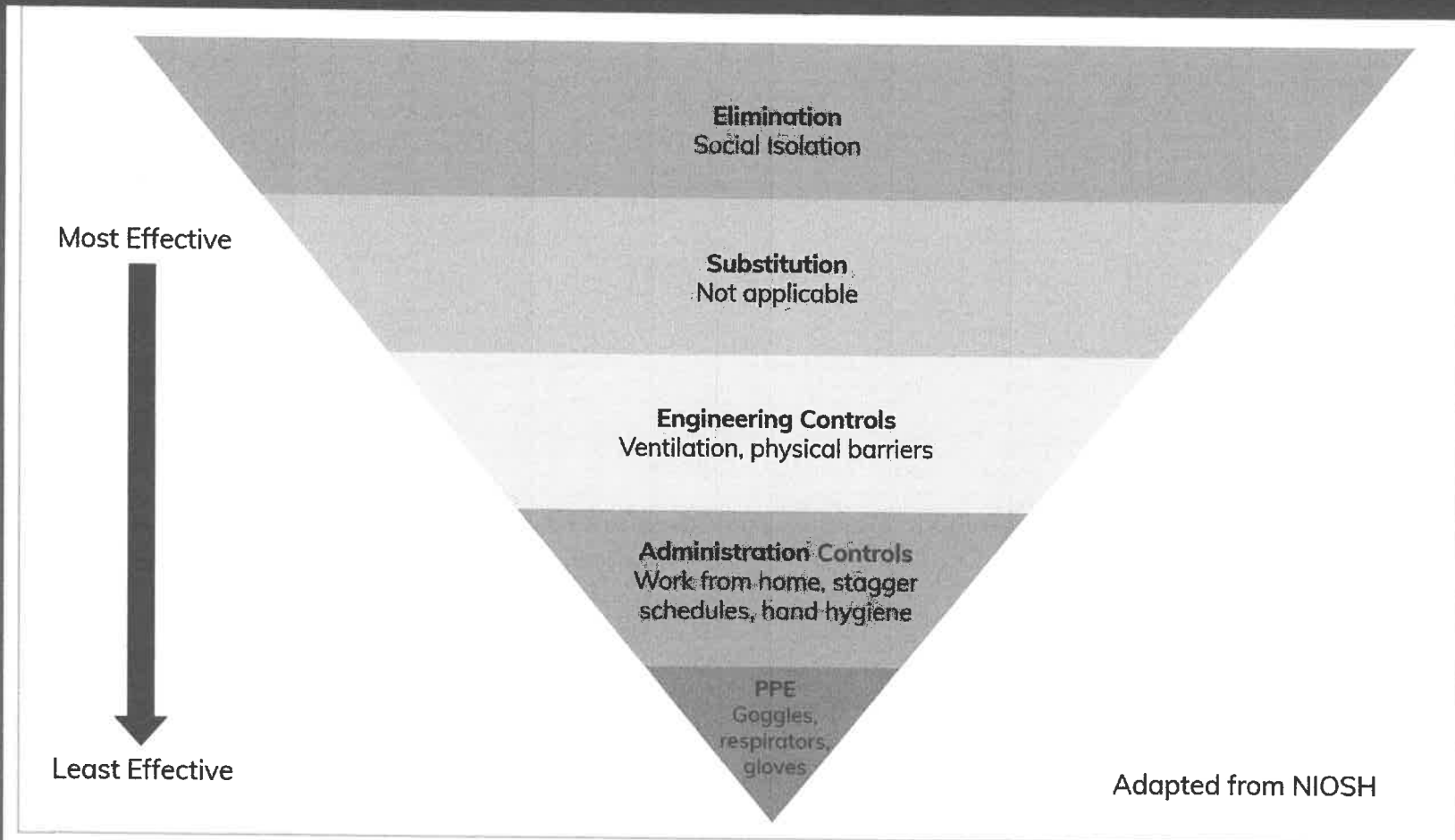


Figure 1: Applying the Hierarchy of Controls for COVID-19.



AIHA – Relative Risk Reductions

Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 23 of 57 PAGEID #: 170

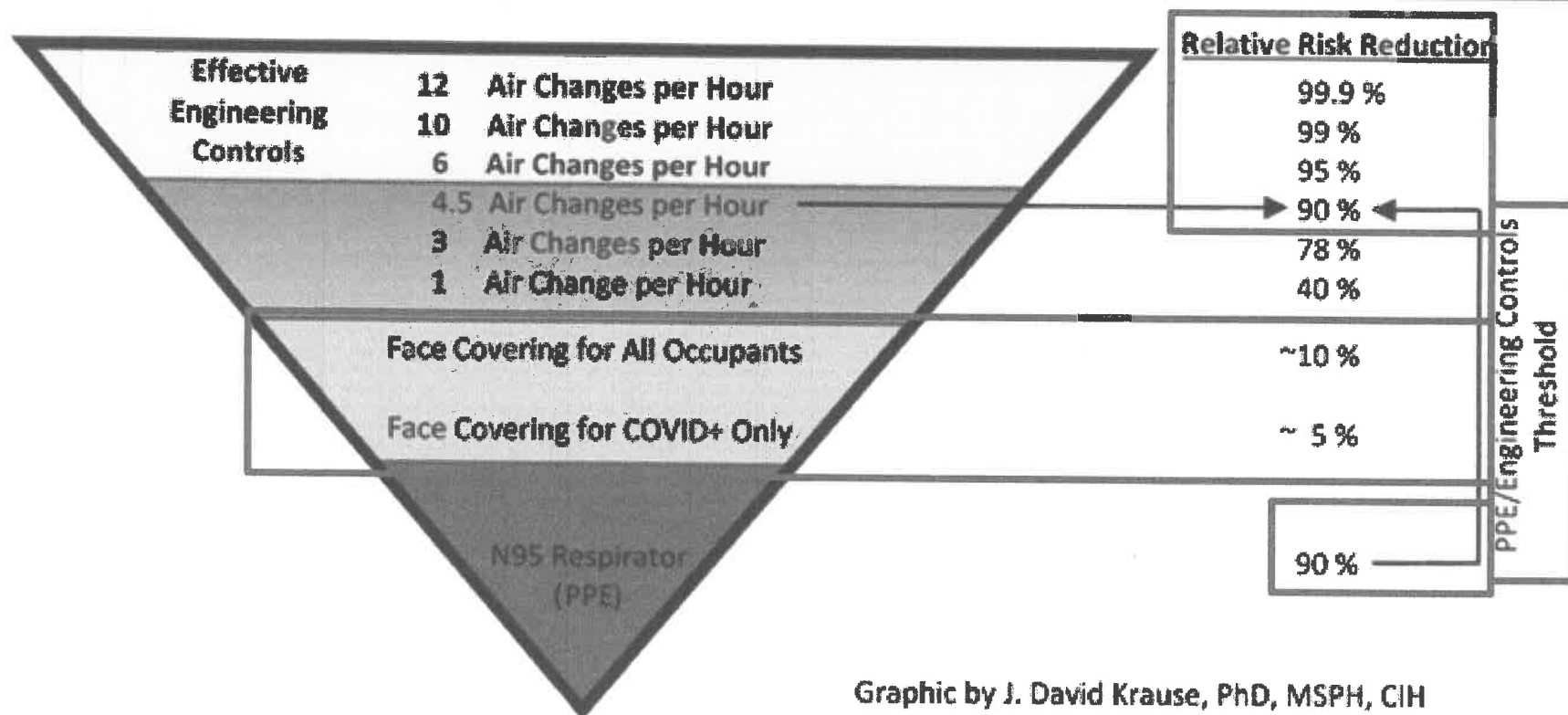


Figure 2*

*To learn how the relative risk reduction estimates were derived for Figure 2, download the [SUPPLEMENT for Reducing the Risk of COVID-19 using Engineering Controls](#).



AIHA – What Does This Mean?

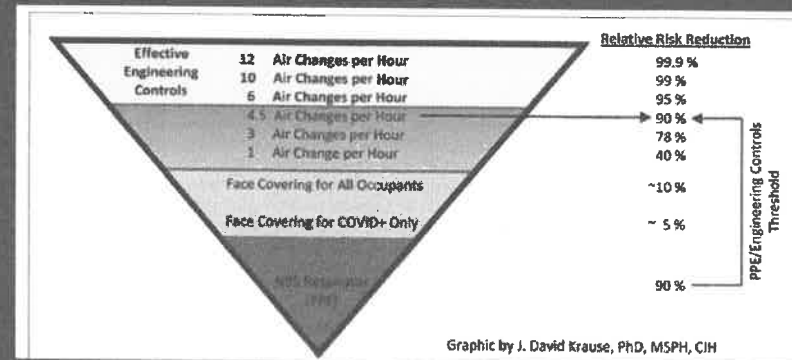
Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 24 of 57 PAGEID #: 171

Exposure Controls Must Have a Relative Risk (RR) Reduction Threshold of 90%!

Masks only have RR of ~5% to ~10% and Do Not Meet 90% Threshold.

≥6 ACH – Ventilation has RR of 90+%.

N-95s – Maybe Not!



AIHA – Mask Remarks

“While not evaluated in this study, face seal leakage is further known to decrease the respiratory protection offered by fabric materials. Aerosol penetration for face masks made with loosely held fabric materials occurs in both directions (inhaled and exhaled). Due to their loose fitting nature and the leakage that occurs even when a face mask is properly worn, a modifying factor of 25% was applied. (???)

AIHA – Mask Remarks

“The impact of typical leakage and frequent non-compliance with proper use and wear, is the basis for a generous estimate of 5-10% relative risk reduction for face masks and cloth face coverings.”

AIHA – Concluding Remarks

Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 27 of 57 PAGEID #: 174

...In light of the limited level of relative risk reduction offered by face coverings and masks the AIHA has recommended engineering controls be used to reduce the risk of exposure in indoor environments,
which is anticipated to reduce the transmission of disease, even in non-healthcare settings.

MERV \geq 17 Filtration Systems Recommended.

OTHER NEGATIVE EFFECTS OF WEARING MASKS

Review

Is a Mask That Covers the Mouth and Nose Free from Undesirable Side Effects in Everyday Use and Free of Potential Hazards?

Kai Kisielinski ¹, Paul Giboni ², Andreas Prescher ³, Bernd Klosterhalfen ⁴, David Graessel ⁵, Stefan Funken ⁶, Oliver Kempfski ⁷ and Oliver Hirsch ^{8,*}

OTHER NEGATIVE EFFECTS OF WEARING MASKS

Increased risk of adverse effects when using masks:

Internal diseases

COPD
Sleep Apnea Syndrome
advanced renal Failure
Obesity
Cardiopulmonary Dysfunction
Asthma

Psychiatric Illness

Claustrophobia
Panic Disorder
Personality Disorders
Dementia
Schizophrenia
helpless Patients
fixed and sedated Patients

Neurological Diseases

Migraines and Headache Sufferers
Patients with intracranial Masses
Epilepsy

Pediatric Diseases

Asthma
Respiratory diseases
Cardiopulmonary Diseases
Neuromuscular Diseases
Epilepsy

ENT Diseases

Vocal Cord Disorders
Rhinitis and obstructive Diseases

Occupational Health Restrictions

moderate / heavy physical Work

Dermatological Diseases

Acne
Atopic

Gynecological restrictions

Pregnant Women

Figure 5. Diseases/predispositions with significant risks, according to the literature found, when using masks. Indications for weighing up medical mask exemption certificates.

Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 30 of 57 PAGEID #: 177

OTHER NEGATIVE EFFECTS OF WEARING MASKS

Abstract: Many countries introduced the requirement to wear masks in public spaces for containing SARS-CoV-2 making it commonplace in 2020. Up until now, there has been no comprehensive investigation as to the adverse health effects masks can cause. The aim was to find, test, evaluate and compile scientifically proven related side effects of wearing masks. For a quantitative evaluation, 44 mostly experimental studies were referenced, and for a substantive evaluation, 65 publications were found. The literature revealed relevant adverse effects of masks in numerous disciplines. In this paper, we refer to the psychological and physical deterioration as well as multiple symptoms described because of their consistent, recurrent and uniform presentation from different disciplines as a Mask-Induced Exhaustion Syndrome (MIES). We objectified evaluation evidenced changes in respiratory physiology of mask wearers with significant correlation of O₂ drop and fatigue ($p < 0.05$), a clustered co-occurrence of respiratory impairment and O₂ drop (67%), N95 mask and CO₂ rise (82%), N95 mask and O₂ drop (72%), N95 mask and headache (60%), respiratory impairment and temperature rise (88%), but also temperature rise and moisture (100%) under the masks. Extended mask-wearing by the general population could lead to relevant effects and consequences in many medical fields.

RESPIRATORS CAN BE FIT TESTED AND SEALED

Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 31 of 57 PAGEID #: 178

Under OSHA, Respirators Intended as Respiratory Protection (29 CFR 1910.134)

Worst



N-95 (Worst)



Air

Purifying

1/2 Face/
Full Face



Supplied

Air

Best

EVEN SUPPLIERS OF N95s WARN AGAINST USE FOR AEROSOLS & INFECTIOUS DISEASE

Case 3:21-cv-00256-TMP-PBS Doc # 1-14 Filed 09/20/21 Page 32 of 57 PAGEID #: 179

Use For

Particles such as those from grinding, sanding, sweeping, sawing, bagging, or processing minerals, coal, iron ore, flour, metal, wood, pollen, and certain other substances. Liquid or non-oil based particles from sprays that do not also emit oil aerosols or vapors. Follow all applicable local regulations. For additional information on 3M use recommendations for this class of respirator please consult the 3M Respirator Selection Guide found on the 3M Personal Safety Division website at www.3M.com/respiratorselector or call 1-800-243-4630 in U.S.A. In Canada call 1-800-267-4414.

Do Not Use For

Do not use for gases and vapors, oil aerosols, asbestos, or sandblasting; particulate concentrations that exceed either 10 times the occupational exposure limit or applicable government regulations, whichever is lower. In the U.S., do not use when the Occupational Safety and Health Administration (OSHA) substance specific standards, such as those for, arsenic, cadmium, lead in the construction industry, or 4,4'-methylene dianiline (MDA), specify other types of respiratory protection. This respirator does not supply oxygen.

Biological Particles

This respirator can help reduce inhalation exposures to certain airborne biological particles (e.g. mold, *Bacillus anthracis*, *Mycobacterium tuberculosis*, etc.) but cannot eliminate the risk of contracting infection, illness or disease. OSHA and other government agencies have not established safe exposure limits for these contaminants.

Even an N95 Respirator is not recommended for larger asbestos particles, aerosols, or to stop illness or disease.

How can a mask do this? It CANNOT.

APORI
fore use. N

se For
rholes such
stal, wood,
rosols or v
iss of resp
www.3M.com

o Not U:
not use k
nes the oc
hen the Oc
admium, ka
is respirat

biologica
is respirat
hyocacteri
overnment

se Instr
Fakuro t
al times
In the U.
meeting
applicat
requirem

The part
Leave it
Store th
Inspect i
for signi
disposal

poor to i
no dam
consider

Conduct
seal, do
Dispose
se Limi

This respirator does not supply oxygen. Do not use in atmospheres containing less than 19.5% oxygen. Do not use when concentrations of contaminants are immediately dangerous to life or health, are unknown or when concentrations exceed 10 times the permissible exposure limit (PEL) or according to specific OSHA standards or applicable government regulations, whichever is lower.

Do not alter, wash, abuse or misuse this respirator.

Do not use with beards or other facial hair or other conditions that prevent a good seal between the face and the sealing surface of the respirator.

Respirators can help protect your lungs against certain airborne contaminants. They will not prevent entry through other routes such as the skin, which would require additional personal protective equipment (PPE).

This respirator is designed for occupational/professional use by adults who are properly trained in their use and limitations. This respirator is not designed to be used by children.

Individuals with a compromised respiratory system, such as asthma or emphysema, should consult a physician and must complete a medical evaluation prior to use.

When stored in accordance with temperature and humidity conditions specified the product may be used until the "use by" date specified on packaging.

Storage Conditions and Shelf Life

For use, store respirators in the original packaging, away from contaminated areas, dust, sunlight, extreme temperatures, excessive moisture and damaging chemicals. When stored in accordance with temperature and humidity conditions specified the product may be used until the "use by" date specified on packaging. Always inspect product and conduct a user seal check before use as specified in these User Instructions. If you cannot achieve a proper seal, do not use the respirator.



End of Shelf Life
Use respirators before the "use by" date specified on packaging



Storage Temperature Range
-20°C (-4°F) to +30°C (+86°F)

Physics of Fluids

ARTICLE

scitation.org/journal/phf

Experimental investigation of indoor aerosol dispersion and accumulation in the context of COVID-19: Effects of masks and ventilation

Cite as: Phys. Fluids **33**, 073315 (2021); doi: 10.1063/5.0057100

Submitted: 17 May 2021 · Accepted: 2 July 2021 ·

Published Online: 21 July 2021



View Online



Export Citation



CrossMark

Yash Shah,  John W. Kurelek,  Sean D. Peterson,  and Serhiy Yarusevych^{a)} 

Abstract: Filtration Efficiencies:

- High-efficiency masks (R95 & KN95): 60% and 46% respectively.
- Cloth Masks (10%).
- Surgical masks (12%).

Not Conservative Because:

- Used 1 μm particles (COVID-19 $\sim 0.1 \mu\text{m}$).
- Sealed mask – no gaps – “Hole(y) Mask” Podcast.

Abstract: Engineering Controls Better:

The results also suggest that, while higher ventilation capacities are required to fully mitigate aerosol build-up, even relatively low air-change rates (2 h^{-1}) lead to lower aerosol build-up compared to the best performing mask in an unventilated space.

Note the use of the term “aerosol.”

OSHA 29 CFR 1910.134 –

Respiratory Protection Standard (RPS)

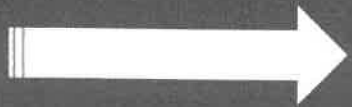
| <u>OSHA 1910.134 RPS Parameters</u> | <u>Mask</u> | <u>Respirator</u> |
|--|-------------|-------------------|
| Medical Clearance to Wear | No | Yes |
| Ability to Wear Facial Hair – Beard | Yes | No |
| Initial Fit Test Requirement | No | Yes |
| Annual Requirement to Fit Test | No | Yes |
| Change-out Criteria for Filter/Cartridge | No | Yes |
| Training on Use of Mask/Respirator | No | Yes |
| Training on Storage of Mask/Resp. | No | Yes |
| Audit of Effectiveness of Program | No | Yes |

CONCLUSION: Masks do not meet key OSHA RPS Requirements!

CDC vs Petty

CDC:

Surfaces



Droplets



Aerosols?

2020



2021

Petty:

Aerosols



Aerosols



Aerosols

It's Always Been About the Little Guys (Aerosols - $< 5 \mu\text{m}$)

RECALL SEEING DUST IN THE AIR

Visible Dust in Sunlight: $>50\text{ }\mu\text{m}$;

~500 times larger than COVID-19

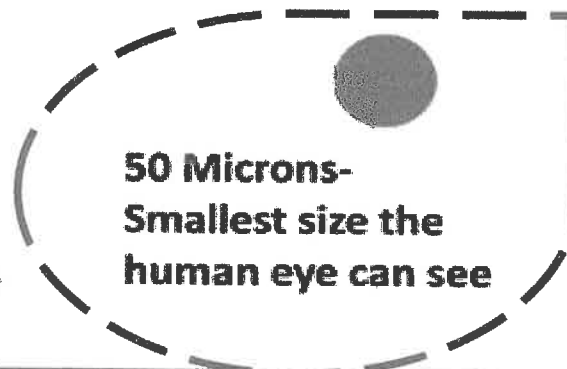


RELATIVE SIZES OF PARTICLES

Thickness of Human Hair:
~100 μm



● **10 Microns-**
Size of typical dust mite

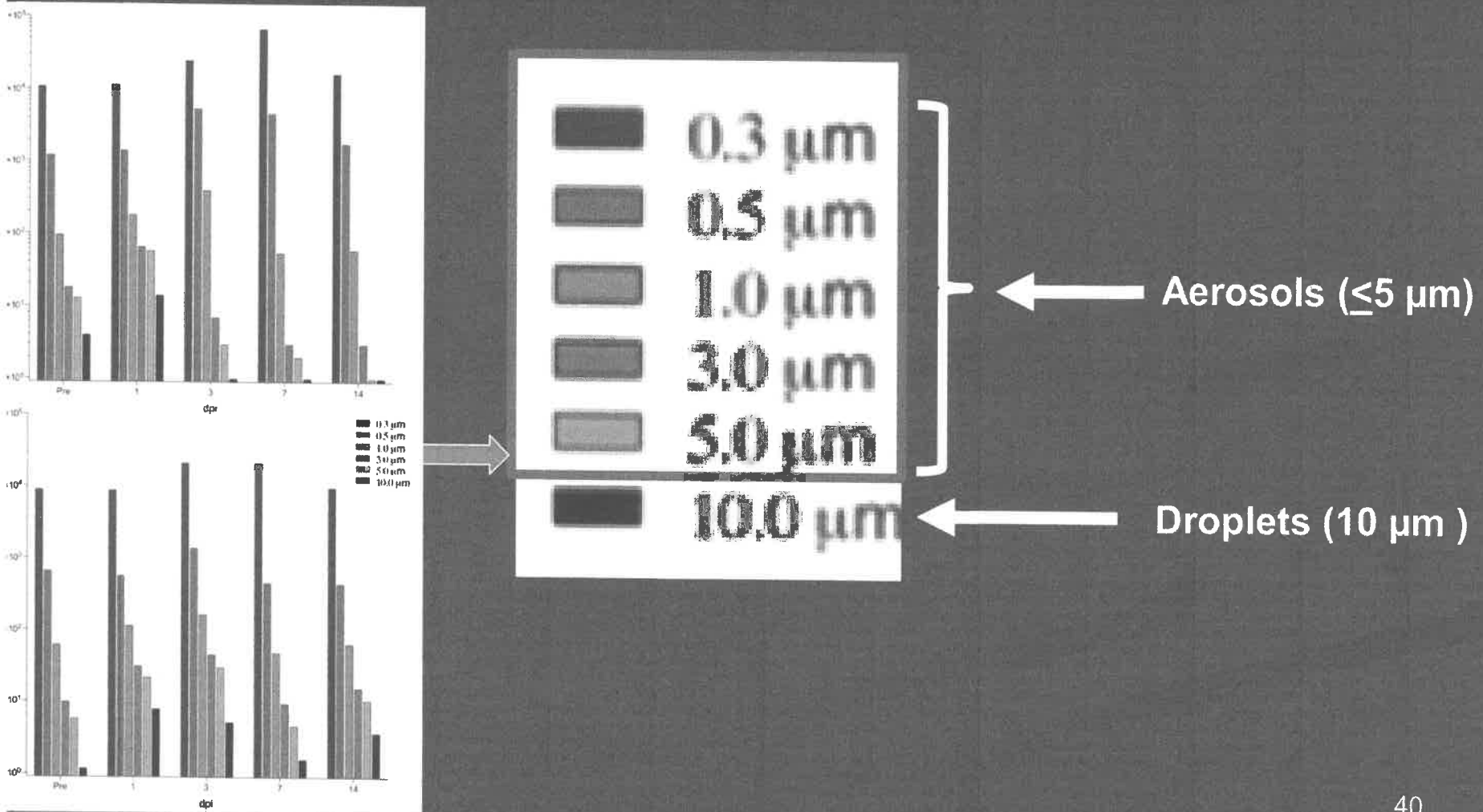


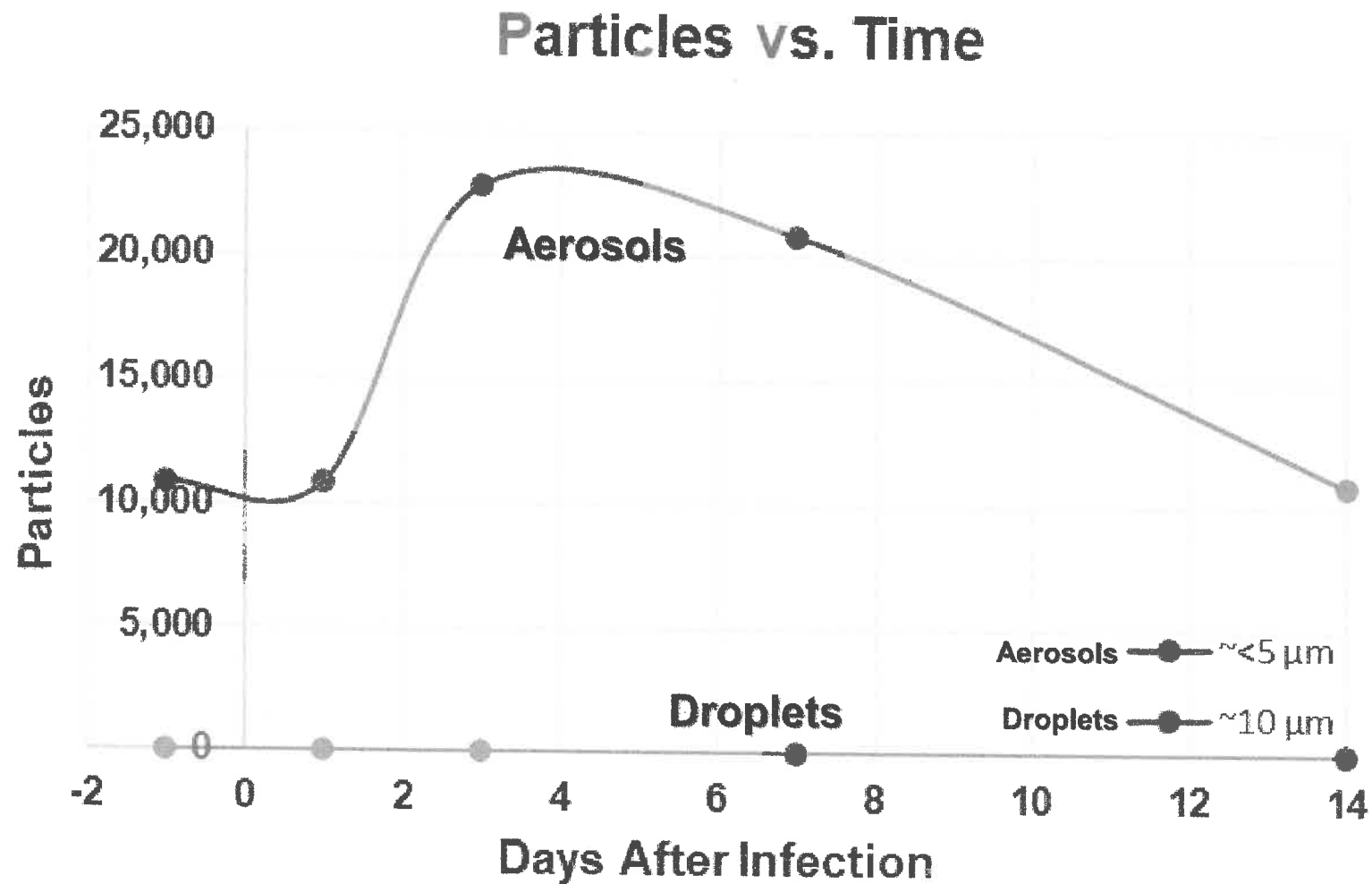
**100 Microns- Thickness of a sheet of
standard paper**

Visible Dust: >50 μm ;

Thickness of Paper:
~100 μm

Data Presented by Size – in Colored Bars





Edwards et al. – Data Simplified

Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 42 of 57 PAGEID #: 189

>99.9% Particles were Aerosols (small guys)

| | Aerosols | Droplets | % Aerosols |
|---------------------|---------------------------|-----------------------|------------|
| Day After Infection | $\sim \leq 5 \mu\text{m}$ | $\sim 10 \mu\text{m}$ | % Small |
| -1 | 10,898 | 1.5 | 99.99% |
| 1 | 10,900 | 9 | 99.92% |
| 3 | 22,847 | 7 | 99.97% |
| 7 | 20,847 | 3 | 99.99% |
| 14 | 10,870 | 6 | 99.94% |

RECALL LITTLE GUYS vs. BIG GUYS

“Big Guys” are Droplets: >5 to $10\text{ }\mu\text{m}$



VS.

“Little Guys” are Aerosols: $\leq 5\text{ }\mu\text{m}$

Little guys are more prevalent and problematic

Conclusions

Our finding that the proportion of small respiratory droplets (i.e., aerosols) [were the majority of particles exhaled in all subjects]...

Case: 21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 45 of 57 PAGEID #: 192

Proceedings from the National Academy of Sciences Press – Edwards et al. – 2/23/2021

CONCLUSIONS FROM THE PAPER:

Our finding that the proportion of small respiratory droplets (i.e., aerosols) [*were the majority of particles exhaled in all subjects*]....

There may be an elevated risk of the *airborne transmission of SARS-CoV-2 by way of the very small droplets that transmit through conventional masks and traverse distances far exceeding the conventional social distance of 2 m (~7')*.

Exhaled aerosol numbers appear to be not only an indicator of disease progression, but a marker of disease risk in non-infected individuals.

SMALL PARTICLES TAKE A LONG TIME TO FALL FIVE FEET IN STILL AIR

Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 46 of 57 PAGEID #: 193



Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 47 of 57 PAGEID #: 194

SMALL PARTICLES TAKE A LONG TIME TO FALL FIVE FEET IN STILL AIR

Stokes Law – How Fast Do Small Particles Fall?

$$V_s = 0.0052 * \text{Specific Gravity} * \text{Diameter}^2$$

Where:

V_s = Falling velocity in ft./min.

Specific Gravity – Density of the particle – virus is ~1.42

Diameter – Diameter of the particle in microns for particles <100 microns

Stokes Law (see Industrial Ventilation Workbook, D. Jeff Burton, 4th edition, 1997)

See also: [https://www.thelancet.com/pdfs/journals/lanres/PIIS2213-2600\(20\)30323-4.pdf](https://www.thelancet.com/pdfs/journals/lanres/PIIS2213-2600(20)30323-4.pdf) – Fennelly - Particle sizes of infectious aerosols: implications for infection control – Lancet – Sept. 2020.

SMALL PARTICLES TAKE A LONG TIME TO FALL FIVE FEET IN STILL AIR

Droplets fall fast – 0.1 to 10 minutes

| Particle Size (μm) | Time to Fall 5' (minutes) |
|------------------------------------|------------------------------|
| 10 | 9.6 |
| 25 | 1.5 |
| 100 | 0.1 |

Assumes still air; in moving air times would be even longer.

SMALL PARTICLES TAKE A LONG TIME TO FALL FIVE FEET IN STILL AIR

Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 49 of 57 PAGEID #: 196

Aerosols Fall Slowly: 0.03 to 59 days

| Particle Size (μm) | Time to Fall 5' (days) | Type of Particle |
|------------------------------------|---------------------------|------------------|
| 0.09 | 58.9 | COVID Aerosol |
| 0.12 | 46.4 | |
| 0.2 | 16.7 | |
| 1 | 0.67 | |
| 5 | 0.027 | |

COVID-19 Fall Very Slowly: 46.4 to 58.9 days

Assumes still air; in moving air times would be even longer.

WHY ARE AEROSOLS – SMALL PARTICLES SO IMPORTANT?

1. Aerosols (very small particles - <5 microns)
can stay suspended for hours to days.

2. Since they stay suspended for so long, they
can actually *accumulate* in concentration in
indoor air rather than dropping out if you
assumed they were droplets.

3. This effectively renders the 6' rule useless.
This also renders masks essentially useless;
they do not filter out aerosols and they
cannot be fitted (gaps around the edges).

REAL INDUSTRIAL HYGIENE SOLUTIONS

Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 52 of 57 PAGEID #: 199

EXPOSURE CONTROL – DILUTION BY VENTILATION OR MAXIMUM FRESH AIR

Dilution of Virus by Dilution and/or Ventilation – More Fresh Air!

- *Spend More Time or Meet Outdoors* – condition of maximum fresh air and dilution of virus – avoid indoors.
- *Ventilation* – Residential and Commercial – Crack open windows or doors – especially with company.

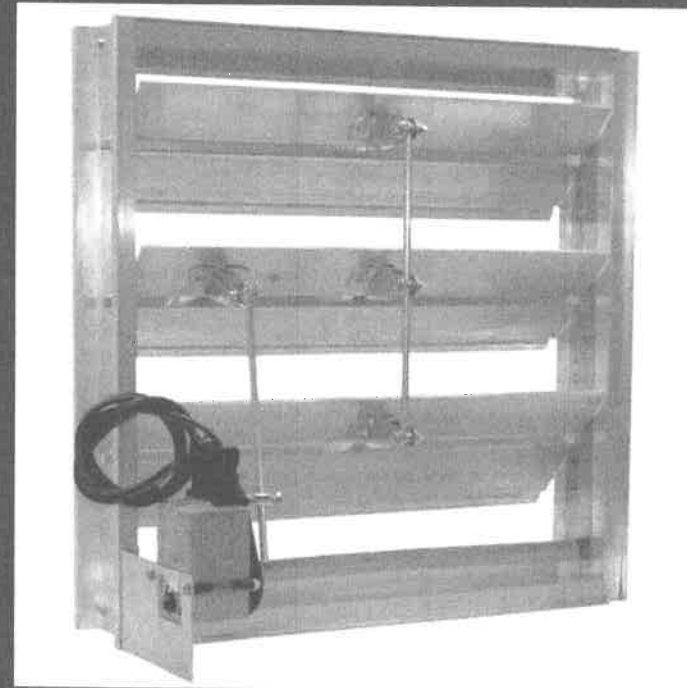


Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 53 of 57 PAGEID #: 200

EXPOSURE CONTROL – DILUTION BY VENTILATION OR MAXIMUM FRESH AIR

Dilution of Virus by Dilution and/or Ventilation – More Fresh Air!

- Ventilation – Commercial and Industrial – Increase fresh air – set fresh air dampers to maximum openings on HVAC systems to maximize fresh air intake – over-ride energy controls – will increase energy costs.

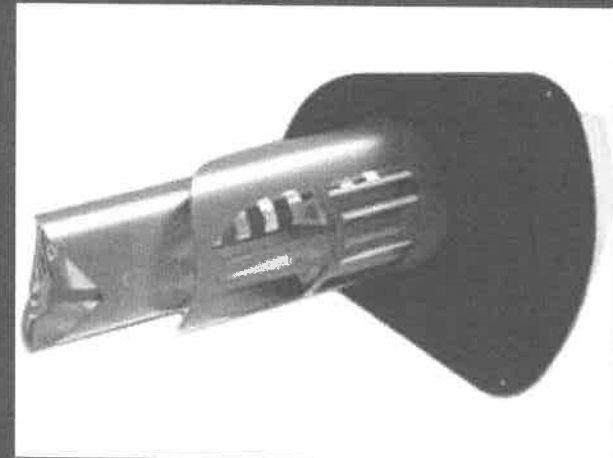


EXPOSURE CONTROL – DESTRUCTION OR REMOVAL OF VIRUS

Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 54 of 57 PAGE ID #: 201

Destruction or Removal:

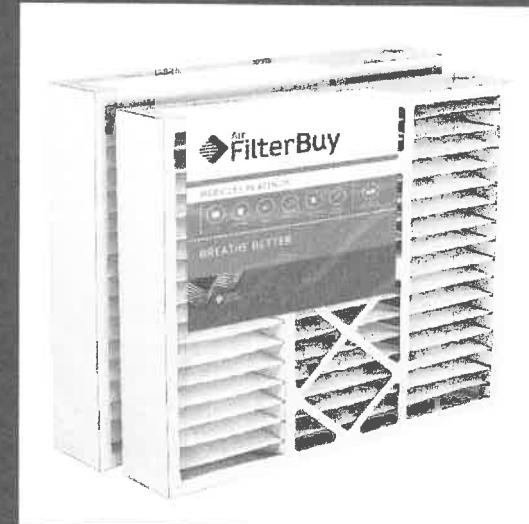
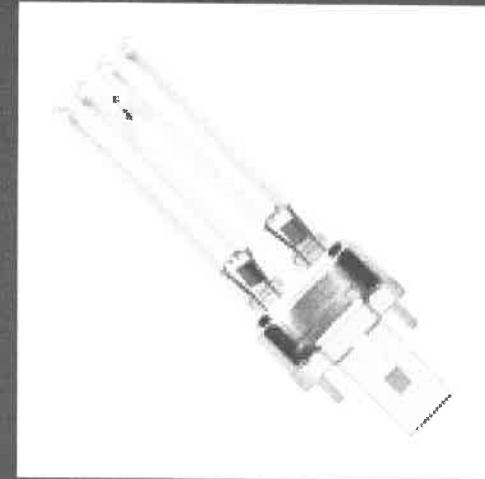
- *Needle Point Ionization Technology* (e.g., Nu-Calgon I-Wave) – add to HVAC intake fans to kill viruses, mold, and bacteria (<https://www.iwaveair.com/sites/default/files/17-S26-PathogensFlyer.pdf>).
- *Ionized Hydrogen Peroxide Systems* (e.g., RGF's Reme Halo in-duct air purifier - <https://www.rgf.com/products/air/remehalo/#undefined>).



EXPOSURE CONTROL – DESTRUCTION OR REMOVAL OF VIRUS

Destruction or Removal:

- **Ultraviolet-C (UVC) Lamps**
(<https://www.fda.gov/medical-devices/coronavirus-covid-19-and-medical-devices/uv-lights-and-lamps-ultraviolet-c-radiation-disinfection-and-coronavirus>).
- **Very High Efficiency Filters (at least MERV-13 filters)**
(<https://www.ashrae.org/file%20library/technical%20resources/covid-19/guidance-for-the-re-opening-of-schools.pdf>).



Case: 3:21-cv-00255-TMR-PBS Doc #: 1-14 Filed: 09/20/21 Page: 56 of 57 PAGEID #: 203

FOUR THINGS TO REMEMBER!

1. **Personal Protective Equipment (PPE) is the least desirable way to protect people.**
2. **Masks are not PPE.**
3. **Scientific evidence suggests COVID-19 particles are mostly small aerosols not droplets, which means respirators, not masks, needed to protect the lungs and would make the 6' rule effectively meaningless.**
4. **Smaller particles are likely a greater cause of disease since they get past PPE and can reach deep into the lungs.**

Use Engineering Controls of Dilution and Destruction.

THANK YOU

Questions Please

spetty@eesgroup.us

754-220-8844